University of California
Los Alamos National Laboratory

INFICOMM

Reflective Wireless Communications System

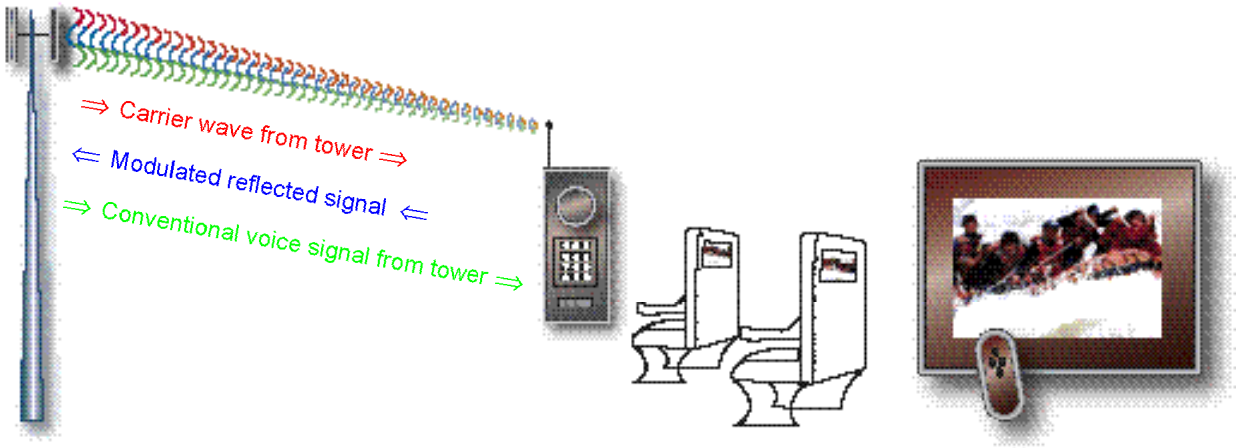
The growth of the wireless-communications industry may ultimately be limited by the dependence of wireless devices on battery power. Batteries determine the remote unit's weight and bulk, as well as its active-usage and standby time between recharges. While battery technologies have advanced over the past decade to allow for much smaller remote units—the smallest now weigh just a few ounces—typical active-usage times are currently limited to around 2 to 4 hours and standby times range from 20 to 40 hours. For many users, this battery life is insufficient for voice services and/or expanded wireless capabilities.

University of California (UC) researchers at Los Alamos National Laboratory have developed a wireless-communications technology that could meet this need for expanded capabilities by providing usage that is essentially unlimited by battery life. Rather than relying on active radio-frequency (RF) transmissions for the return path as in traditional wireless communications, the Los Alamos technology uses a technique called modulated reflectance.

With this INFICOMM technology, a remote wireless device will have vastly increased air time with current or even smaller battery sizes. Device battery power will mainly be used to operate its memory and electronic-display functions. This technology, which is still in development for wireless device applications, will allow essentially unlimited air times necessary for expanding wireless voice and data applications.

Applications

The INFICOMM technology has great advantages for many wireless, remote-communications applications. In addition to improving the efficiency of standard wireless networks, it can be used for remote-communications networks where laying wire connections is too time consuming or costly. For example, in a manufacturing setting, each robotic unit across an entire plant could be equipped with a receiver-reflector to wirelessly report unit status and receive new instructions. The elimination of data-communication lines would facilitate reconfiguring the production line. Remote-sensing networks for industry (warehouses, oilfields, delivery/transportation, etc.), government (environmental, seismic, weather, or air-quality monitoring), and scientific research often span many square miles (sometimes hundreds of miles). In addition, the sensors must often be placed in hazardous locations or are physically inaccessible. With current technology, these sensor/reporting units must be serviced regularly to replace/recharge batteries or their reporting lifetime is limited to a single battery discharge. INFICOMM technology can greatly expand and enhance the utility of these applications. Finally, using INFICOMM in an interactive, high-density, distributed-communications setting such as an university lecture hall or auditorium (particularly when the lecture is transmitted to remote sites) can lead to significant savings in installation costs.



Our wireless receiver-reflector device modulates and reflects the transmitter-receiver base unit's radio-frequency carrier wave to complete half the "conversation." The other half is transmitted from the base unit using conventional techniques.

INFICOMM How It Works

Modulated reflectance is a technique originally developed for national-defense purposes; however, its elegant simplicity makes it useful for a wider range of applications.

The fundamental principle of modulated reflectance works much like sunlight reflecting off of a mirror. A transmitter-receiver base unit emits carrier waves of RF energy, and each remote wireless device (a receiver-reflector) would modulate these waves to correspond to the voice/data signal and reflect them back to the tower. The transmitter-receiver base unit would then receive these modulated waves. Thus, half of the duplex "conversation" is transferred from the remote unit to the base unit using modulated reflectance, while the other half is transferred from the base unit to the remote wireless unit using conventional RF energy techniques.

Because INFICOMM is very energy efficient, extra battery power can be applied toward improving bit error rates over current cell-phone technology. This could be achieved by use of compression and turbo codes. The INFICOMM technology also demonstrates flexibility with two forms of implementation ("hybrid" and "pure").

Benefits

- Provides essentially unlimited usage-time
- Minimizes costs and impact of distributed-communication installation
- Eliminates RF emissions from the remote unit
- Minimizes impact of battery disposal on the environment

In the "hybrid" manifestation of the technology, essentially no change to cellular-tower infrastructure is required. In this design, a cellular telephone uses modulated reflectance to reduce the power consumption of the battery but also retains standard transmission modes of operation, much like a standard cell phone, as a supplement to the reflected signal. Enhancement of the battery-charge life is expected to be highly significant and radiation exposure to the user is reduced. All of the "magic" in this system is in the handset.

In the case of a "pure" modulated-reflectance network, it is possible (because the remote wireless unit requires no transmitter power) to configure the unit for extremely long battery-charge life, many times that of current cell-phone systems, and radiation exposure to the user is reduced to zero. This further enhanced performance is partially realized by changes to the tower infrastructure in addition to improvements to the remote unit, and therefore, its implementation requires a higher investment.

INFICOMM is compatible with all common RF link methods used in the cell-phone industry including TDMA, CDMA, GSM, and high-speed data applications.

In traditional wireless communications networks, RF energy emitted from the remote unit antenna completes the duplex connection. INFICOMM eliminates this emission.

The INFICOMM technology is also far more environmentally friendly than current wireless communications technologies. As wireless usage expands, so do the ecological implications of battery disposal. Rechargeable batteries contain significant amounts of dangerous substances, often toxic metals, and in some cases, explosive materials. While the batteries are rechargeable, they still have limited life expectancies, and they ultimately end up in local landfills. The billions of batteries that will be disposed of as wireless-communications usage expands worldwide will create significant waste-management issues in the coming years. The INFICOMM technology could serve to minimize this problem.

Wireless remote unit manufacturing costs could be lowered with the elimination of batteries for transmission purposes and the related power amplifier. In addition, the associated electronic packages may be simplified.

Status

While we are still in the development stage with substantial engineering ahead, we have already transmitted video images using modulated-reflectance technology over several kilometers. UC is currently seeking patent protection that covers key elements of the INFICOMM technology.

UC is interested in licensing this technology on an exclusive or nonexclusive basis. UC would also be available to assist in the development of the technology through a sponsored research arrangement or cooperative research and development agreement. The inventors have also indicated a willingness to consider alternative development options to assist in the commercialization of the technology, unrelated to UC.

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LALP-01-185